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NOTES ON GEOGRAPHIC DISTRIBUTION

Check List 17 (3): 895–903
https://doi.org/10.15560/17.3.895

PENSOFT

# First report of the rare arboreal grasshopper *Bactrophora dominans* Westwood, 1842 (Insecta, Orthoptera, Caelifera, Romaleidae) from Brazil

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**Abstract**

The genus *Bactrophora* Westwood, 1842 comprises only two species known from Central America and northern South America, with a notable scarcity of collected specimens. Herein, we provide the first records of the presence of this genus in Brazil. These new records, based on entomological collection data and photographic records, extend the known distribution of *Bactrophora dominans* Westwood, 1842 to include the Brazilian Amazonian region. Both records emphasize the importance of natural history collections and the significance of the iNaturalist web-based application as an instrumental tool in this discovery.

**Keywords**

Amazon, grasshopper, distribution, diversity, iNaturalist, new record

**Academic editor:** Pedro G.B. Souza Dias | Received 15 January 2021 | Accepted 29 April 2021 | Published 9 June 2021

**Citation:** Silva DSM, Tavares GC, Fianco M, González JM (2021) First report of the rare arboreal grasshopper *Bactrophora dominans* Westwood, 1842 (Insecta, Orthoptera, Caelifera, Romaleidae) from Brazil. Check List 17 (3): 895–903. https://doi.org/10.15560/17.3.895

## Introduction

Bactrophorinae is a peculiar group of Neotropical grasshoppers characterized by small to medium-sized species, usually both sexes are brachypterous or micropterous, with strong hind legs, large globular protruding eyes, filiform antennae normally longer than head and thorax combined, second tarsomere of hind leg almost same length or longer than the first one, and tarsi and ventral surface of abdomen bearing sensory bristles (Rowell 2013). The subfamily comprises three tribes, over 40 genera, and about 200 species (Rowell 2012; Cigliano et al. 2021), and among them, *Bactrophora* Westwood, 1842 is possibly the most distinct taxon, easily recognized by the unusually long rostrum, derived from a remarkable fastigium (Rowell 2013). *Bactrophora* has a Central American–Amazonian distribution, and it is regarded as a member of a clade that includes the most basal groups

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within the Bactrophorini, one of the three tribes within the subfamily (Amédégnato et al. 2012).

There are only two known species within the genus *Bactrophora*: *B. dominans* Westwood, 1842, and *B. mirabilis* (Bruner, 1905). While *B. mirabilis* can be distinguished by a fastigium process whose apex is acuminate and pronotal tubercles strongly marked, *B. dominans* fastigium process is larger, with expanded apex, and the pronotal surface has less developed tubercles (Bruner 1905; Rehn 1938). As most Bactrophorinae are forest-dwelling and many genera, including *Bactrophora*, are known to be arboreal, they are difficult to observe, study and collect, contributing to the scarcity of knowledge on the subfamily (Rowell 2012; González et al. 2015). Not surprisingly, very few studies have been published regarding *Bactrophora*, and among them, we highlight the studies of Rehn (1938) and González et al. (2015). The latter authors recorded the latest known *B. dominans* specimens from Venezuela and French Guiana.

There is a tremendous scarcity of preserved specimens of *Bactrophora*; there are only four specimens of *B. mirabilis* known, collected in Costa Rica (Rehn, 1938; González et al. 2015; Cigliano et al. 2021), and 10 specimens of *B. dominans*, from few localities in northern South America (Table 1). As the latter species has a wide distribution in forest environments, it was suspected that it could be found in Brazil (Rowell 2013; González et al. 2015).

During an orthopterology course taught by Dr. Pedro G.B. Souza-Dias, we found a new record of *B. dominans* from the Brazilian Amazonian region that was uploaded to the iNaturalist platform (https://www.inaturalist.org/observations/58283814). Another specimen was later found in the collection of the Universidade Federal do Pará (UFPA). Both findings allow us to report the first records of *Bactrophora dominans* in Brazil, thus enhancing the known distribution of the species. Specimen photos, as well as a table with relevant information and a distribution map, are included.

## Methods

One female specimen of *B. dominans* (Fig. 1; Table 1) was found in September 2020 inside a house in the surroundings of Manaus municipality, Amazonas state, Brazil. The specimen was photographed (Fig. 1), and the image was uploaded to iNaturalist, a web-based application designed to capture and share photo-based records of plants and animals worldwide. At the time of the observation, a female was also found in a collection at the Universidade Federal do Pará (UFPA) (Figs. 2, 3). The specimen was collected on 1-xi-2008 by fogging in Urucu River, Coari municipality (Amazonas State, Brazil) (Figs. 2, 3; Table 1). This specimen will be deposited in the entomological collection of the Museu Paraenese Emílio Goeldi (MPEG). The pinned specimen was measured and later photographed using a Leica M205 stereomicroscope equipped with a Leica DFC 450 camera. The measurements (mm) were defined as follows: body length (b), as the distance between the apex of the rostrum and the end of ovipositor; pronotum (p), as the maximum distance between the anterior and posterior borders of the pronotal disc; hind femur (hf), as the distance between the base of the hind femur and its genicular lobes; and tegmina (tg), as the distance between the base and the apex of tegmina. Both specimens were identified using the related literature (Westwood 1842; Martínez 1921; Rehn 1938; Rowell 2013; González et al. 2015) and compared with type and other voucher specimens.

**Figure 1.** *Bactrophora dominans* Westwood, 1842, female specimen from Manaus, Amazonas State (Brazil), presented in iNaturalist, https://www.inaturalist.org/observations/58283814. (Photo: Thalisson Torres)

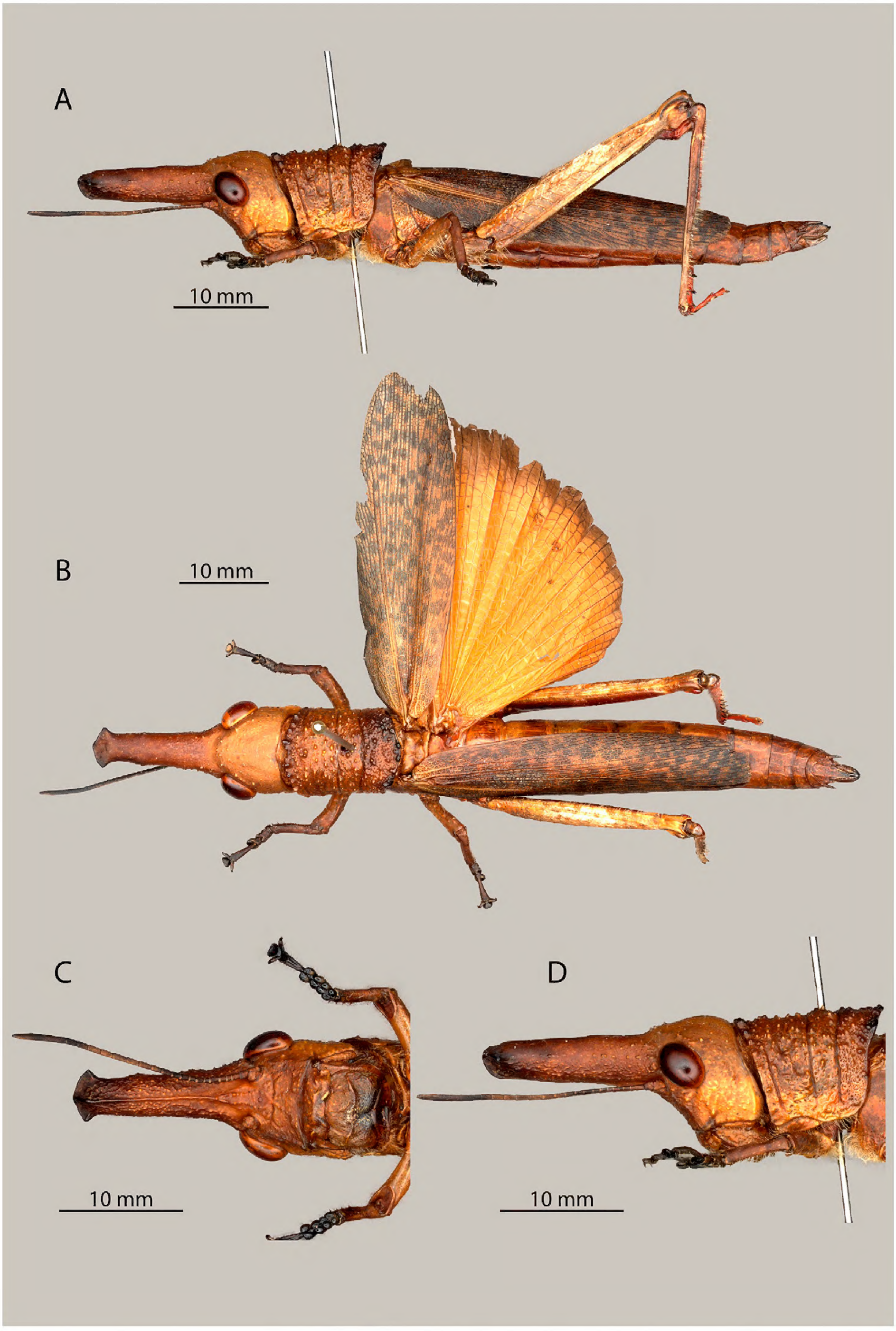


**Figure 2.** Female *Bactrophora dominans* Westwood, 1842 (UFPA, Brazil). **A.** Habitus in lateral view. **B.** Dorsal view. **C.** Head in ventral view. **D.** Head in lateral view.

**Table 1.** Data for all records ever made for *Bactrophora dominans* Westwood, 1842 (including information of this study).

| Locality | Sex | Number of specimens | Reference |
|---|---|---|---|
| Unknown | Female | 1 | Westwood 1842 |
| Colombia (the exact location is doubtful) | Male | 1 | Martínez 1921; Rehn 1938; González et al. 2015 |
| Guyana, Rupununi River | Male | 1 | Martínez 1921; Rehn 1938; González et al. 2015 |
| Guyana, Colombia, Brazilian and Peru Amazon | — | — | Rowell 2013* |
| Northern South America, Colombia, Venezuela, Guianas, Suriname, northern Brazil | — | — | González et al. 2015* |
| Venezuela, Bolívar state (Ichum River in the Tepui Ichum) 04°28′12.53″N, 063°20′36.27″ | Female | 1 | González et al. 2015 |
| French Guiana (Bélizon trail, going to Regina road) | Female | 1 | González et al. 2015 |
| French Guiana (Kapiri trail, close to the town of Regina) | Female | 2 | González et al. 2015 |
| French Guiana | Unknown sex | 1 | Giugliaris in González et al. 2015 |
| Brazil, Amazonas state (Urucu river, Coari) 04°52′33.5″S 065°16′46.3″W | Female | 1 | Silva et al.2021 |
| Brazil, Amazonas state | Female | 1 | iNaturalist |

* Distribution estimates found in the literature.

Additional photographs (without scale bar) of other specimens of *B. dominans* and *B. mirabilis* (including the types) were made available by the curatorial staff of the Museum of Natural History London, UK (NHMUK), Instituto Nacional de Biodiversidad, San Jose, Costa Rica (INBio), Academy of Natural Sciences of Drexel University, Philadelphia, USA (ANSP), and Museo Nacional de Ciencias Naturales, Madrid, Spain (MNCN) (Fig. 4).

The current known distribution of *B. dominans* was obtained from specimens' labels, from the photo deposited at iNaturalist and literature records. Imprecise geographic locations were discarded. Any additional information (not originally included in specimens' labels) are presented within brackets. The map was built using QGIS (v. 3.10.2 with GRASS 7.8.2) with QuickMapServices function. The final editing was made in Inkscape (0.9.1) (Fig. 6).

Some labels' data needed to be corrected, and approximated coordinates were provided. The locality named "Pozo Azul" was mentioned by Rehn (1938) as "Pozo Azul de Pirrís, plains of the Rio Grande de Pirrís, western Costa Rica". This river is also known as Parrita River, and we used an approximated coordinate available in mindat.org. Rehn (1930) also corrected the transliteration error of the locality in Guyana named "R. Paruni" for Rupununi River. Both specimens from INBio have coordinates on the original labels (in UTM format but the zone was not included). However, these coordinates were incorrect when written as "L-S" (i.e., South Latitude) and Costa Rica is in North Latitude. Even after correcting to "North Latitude" and using the UTM zones where Costa Rica is inserted (i.e., 16 and 17), the original coordinates corresponded to points in the Pacific Ocean more than 400 km from the Pacific coast of Costa Rica. The labels have the locality named (i.e., Corcovado National Park), so we strongly believe that someone mistook the coordinates while preparing the labels. We used approximate coordinates of the localities instead.

## Results

***Bactrophora dominans* Westwood, 1842**
Figures 1–3

**New records.** BRAZIL – Amazonas • Manaus; 03°05′ 27″S, 059°57′58″W; 08.IX.2020; 1♀, [https://inaturalist.

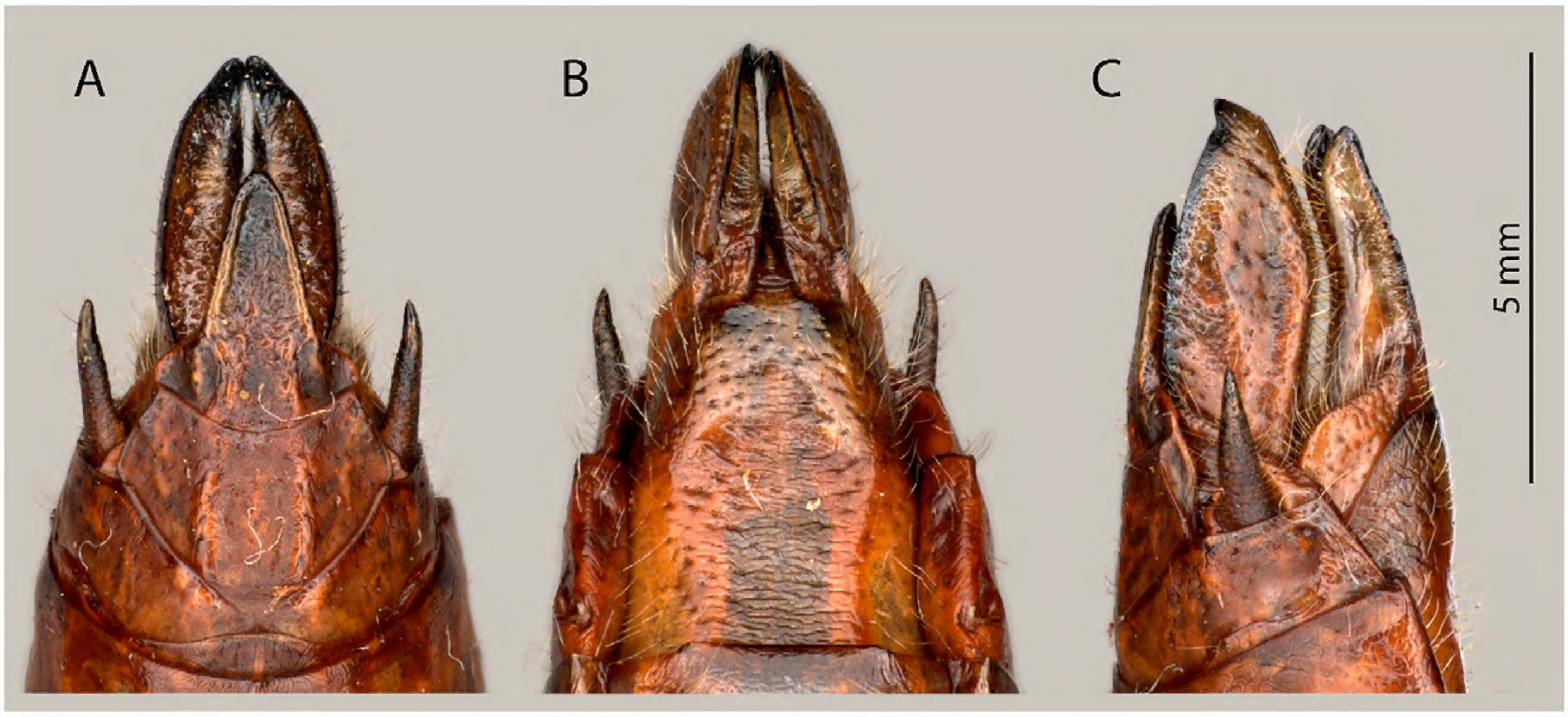


**Figure 3.** *Bactrophora dominans* Westwood, 1842 female terminalia (UFPA, Brazil). **A.** dorsal view. **B.** Ventral view. **C.** Lateral view.

org/observations/58283814] • Coari, Urucu River; 04°52′33″S, 065°16′46″W; 01.XI.2008; J.A.M. Fernandes leg.; 1♀, pinned, MPEG.HEX05050457.

**Additional material examined.**

***Bactrophora dominans*** • no collecting data; *Bactrophora dominans* Westwood Type; 80[illegible number]7; 1 ♀, pinned, ANSP. B.

GUIANA [GUYANA] – [Upper Takutu–Upper Essequibo] • R. Paruni [Rupununi River]; [03°47′25″N, 058°59′04″W]; V.1916; C.E. Bodkin leg.; Pres. by Imp. Bur. Ent. 1920–350; 552; 1 ♂, pinned, NHMUK.

[COLOMBIA] • Santa Fé Bogotá [according to Rehn (1930), the exact location is doubtful, but certainly it is not Bogotá]; 1 ♂, pinned, MNCN_Ent 119721, CSIC-MNCN.

FRENCH GUIANA – [Cayenne] Bélizon trail; [04°16′26″N, 52°38′35″W]; 14.XII.1989; J.L. Giugliaris leg.; close to light; 1♀; J.L. Giugliaris Collection. • Regina, Kapiri Trail [04°18′35″N, 052°08′03″W]; 02.VIII.2008; J.L. Giugliaris leg.; Glass Interception trap, 2♀; one in J.L. Giugliaris Collection, the other in an undisclosed private collection.

VENEZUELA – Bolívar • Ichum Tepui; 04°28′12.53″N, 063°20′36.27″W, alt. 650m; 7.III.2013; 1♀; MIZA-UCV.

***Bactrophora mirabilis.*** COSTA RICA – [Puntarenas] • Pozo Azul [09°30′0″N, 84°19′33″W]; June; [C.F.] Underwood leg.; *Scolocephala mirabilis* Bruner Type; 1 ♂, pinned, ANSP Type H308 • Osa península, 3–10 mi S. Rincón [3–10 miles south of Rincón, Arboreal Habitat Insecticide sta. 36; [08°33′24″N, 083°27′54″S]; 7–20.II.1967; H.R. Roberts, E.H. Roberts, M.S. Harrison, W.W. Moss, D.A. Nickle leg.; 1 ♀, pinned, ANSP • P. N. Corcovado, Sector La Leona, Cerro Puma, #74481; L-S-267700 518900 [08°26′51″N, 083°29′09″W]; 100–300 m alt.; 21.VI–10.VII.2003; M. Moraga. Libre [leg.?]; 1 ♀, pinned, INBio INB0009734486 • P. N. Corcovado, Est. Sirena; 0–100m; L-S-270500, 508300 [08°28′24″N, 083°35′36″W]; IV.1990; Fonseca leg.; 1 ♂, pinned, INBio INBIOCRI000921673.

**Identification.** According to Rehn (1938), the following characteristics can easily distinguish the only two known *Bactrophora* species: *Bactrophora dominans* is characterized by the apex of the fastigium process expanded laterally (Figs. 4A–B, 5A–D); pronotal surface with tubercles less developed and not blackish (Figs. 4A–B, 5A–D); tegmina narrower, with well-defined rectangular areolation, and longitudinal veins intercalated with conspicuous regular and parallel longitudinal nervures (Fig. 5E); inner surface of hind femur dull greenish, with base and distal fifth orange-red to carmine; hind tibia externally dull purplish, internally carmine, distal border of the penultimate male tergite with a shallow rectangular emargination, flanked by a pair of tiny acute projections and another, much larger pair (Fig. 5F). On the other hand, *Bactrophora mirabilis* has the apex of the fastigium process acuminated, conical (Figs. 4D, E, 5G–J); pronotal tubercles more prominent, distinctly blackish (Figs. 4D, E, 5G–J); tegmina broader, with only irregular areolation between the principal longitudinal veins, no notable longitudinal nervure marked (Fig. 5K); inner surface of hind femur dull carmine, with genicular lobes dark purplish olivaceous; hind tibia externally grayish olivaceous and internally dark purplish olivaceous; distal border of penultimate male tergite more deeply emarginate, boarded by a pair of pronounced acute projections (Fig. 5L). Body length = 90.7 mm; pronotum = 12.6 mm; hind femur = 28.4 mm; tegmina = 42.0 mm.

## Discussion

This study was possible only due to the use of two important tools for the study of biodiversity: museum collections and online social media. During these days of increasing environmental degradation and rates of extinction in certain groups, natural history museums and collections are even more important as they are repositories of biodiversity, and, in many cases, house vouchers and type specimens with important information for genetic, phylogenetic, biogeographic, and ecological studies (Lane 1996; Burrell et al. 2015; Ceballos et al. 2017; Schmitt et al. 2018; Domagała and Dobosz 2019). Museum collections also provide records of the distribution and natural history of organisms, essential information in understanding biodiversity (Konstantivov and Namytovac 2019).

The records of *Bactrophora dominans* in northern South America (Fig. 6) are still scarce, but these new records were expected (González et al. 2015). However, until this study, the species had not been found in Brazil. The finding of a specimen of *Bactrophora* in a collection, increases the distribution of this genus and supports the importance of these repositories as witnesses of the biodiversity that exists in natural environments (Domagała and Dobosz 2019; Konstantivov and Namytovac 2019). The specimen of *B. dominans* in the UFPA collection was originally collected using fogging, as has been the case for *B. mirabilis* (Roberts 1973). This supports the idea that *Bactrophora* species are arboreal and more than probably live in the forest canopy (Roberts 1973; González et al. 2015).

The union of taxonomy and technology through online social media, such as iNaturalist, allows records citizens and researchers to provide important scientific information and distributional data on several insect groups, such as termites (Hochmair et al. 2020), pygmy grasshoppers (Skejo et al. 2020), monkey grasshoppers (Olivier et al. 2020), and raspy crickets (Cadena-Castañeda et al. 2020). The iNaturalist platform also can help record the presence of invasive insects such as ladybird beetles (Hiller and Haelewaters 2019). In our study, the iNaturalist record allowed us to verify details of the morphology and coloration of a living female, as most of the

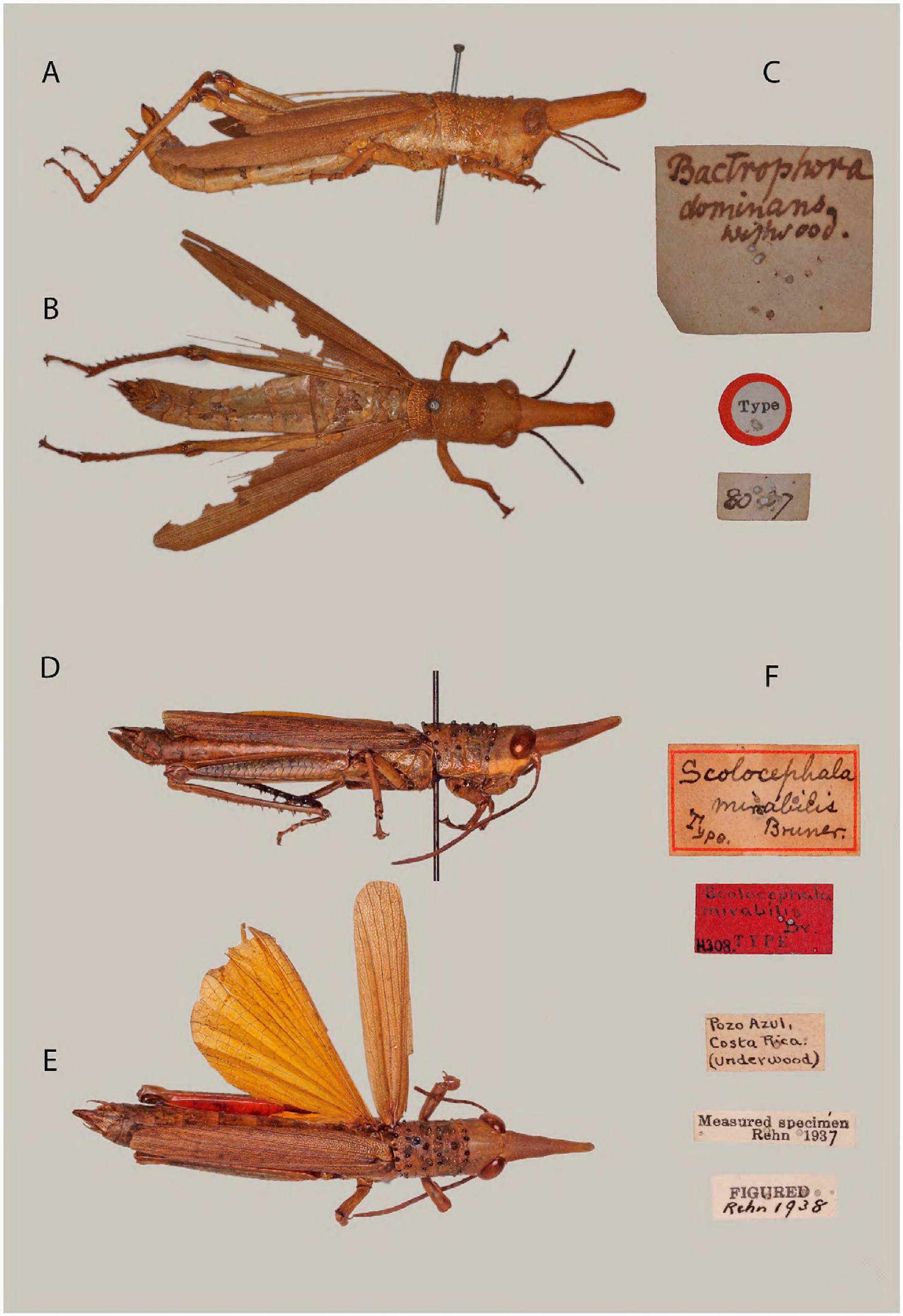


**Figure 4.** *Bactrophora* Westwood, 1842 type specimens. **A–C.** *Bactrophora dominans* Westwood, 1842 (NHMUK): (**A**) lateral view; (**B**) dorsal view; (**C**) labels. **D–F.** *Bactrophora mirabilis* (Bruner, 1905): (**D**) lateral view; (**E**) dorsal view; (**F**) labels. Figures not at scale. (ANSP, Philadelphia, USA).

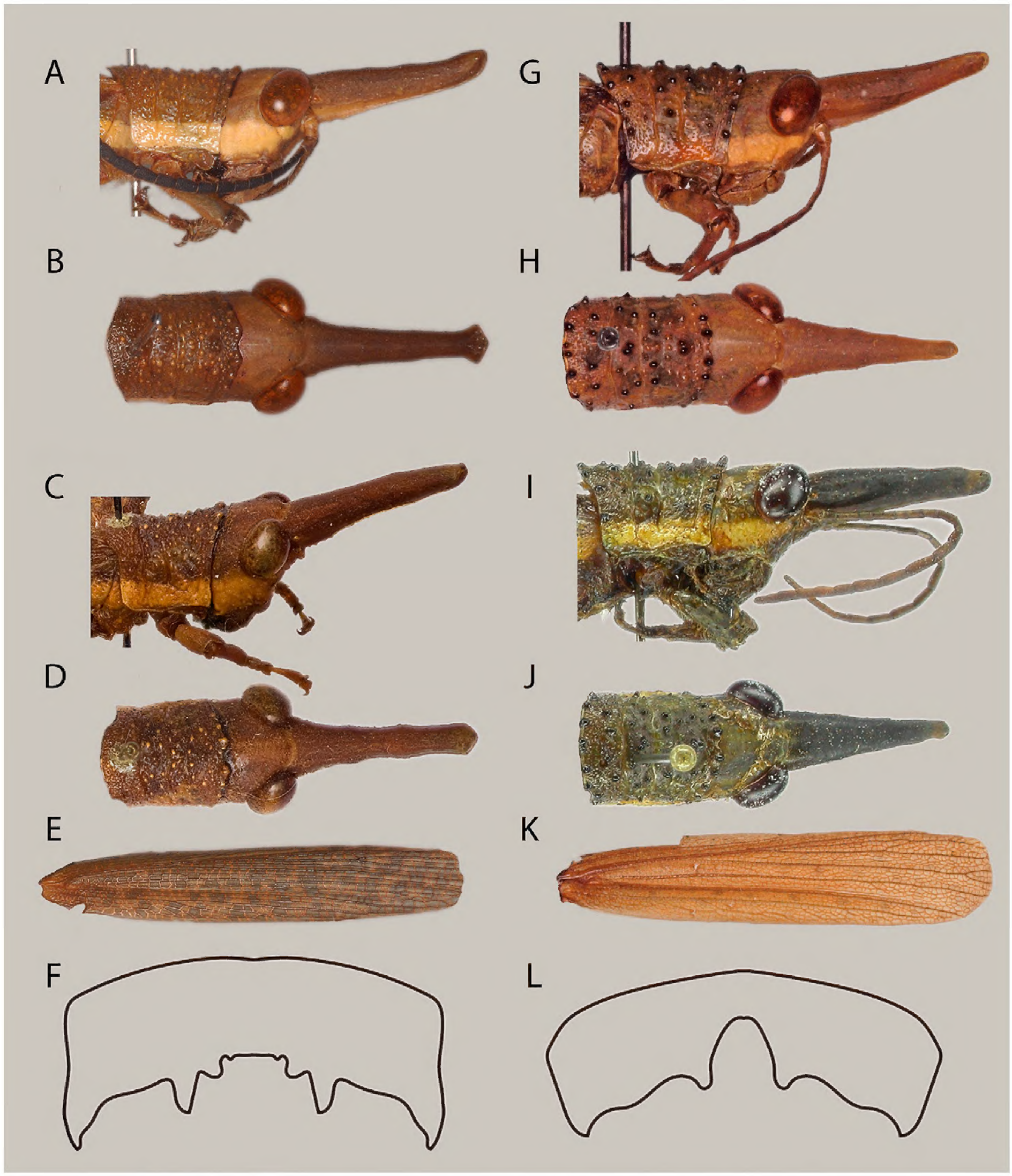


**Figure 5.** *Bactrophora dominans* Westwood, 1842. **A.** Head in lateral view and **B.** Head in dorsal view (UFPA). **C.** Head in lateral view and **D.** Head in dorsal view (CSIC-MNCN). **E.** Tegmina shape and **F.** Penultimate male tergite shape (UFPA). *Bactrophora mirabilis* (Bruner, 1905) **G.** Head in lateral view and **H.** Head in dorsal view (ANSP). **I.** Head in lateral view and **J.** Head in dorsal view (INBIO). **K.** Tegmina shape and **L.** Penultimate male tergite shape (ANSP). (Figures not at scale)

limited data on this genus come from museum material and, consequently, some characteristics are lost with specimen preparation.

Data on the biology, natural history, and geographic distribution of *Bactrophora* species are still poorly known (González et al. 2015), and some details about the phallic complex and female genitalia are still unexplored.

## Acknowledgements

This study has benefited from the facilities provided by CNPq/Programa SISBIOTA Brasil (Edital 712 MCT/CNPq/MMA/MEC/ CAPES/FNDCTeFAPEMIG-Ação Transversal/FAPs 166 no. 713 47/2010, process no. 563360/2010-0), PROTAX/CNPq/ FAPEMIG (process no. 440664/2015–2 714 and APQ—04154-15) and CNPq

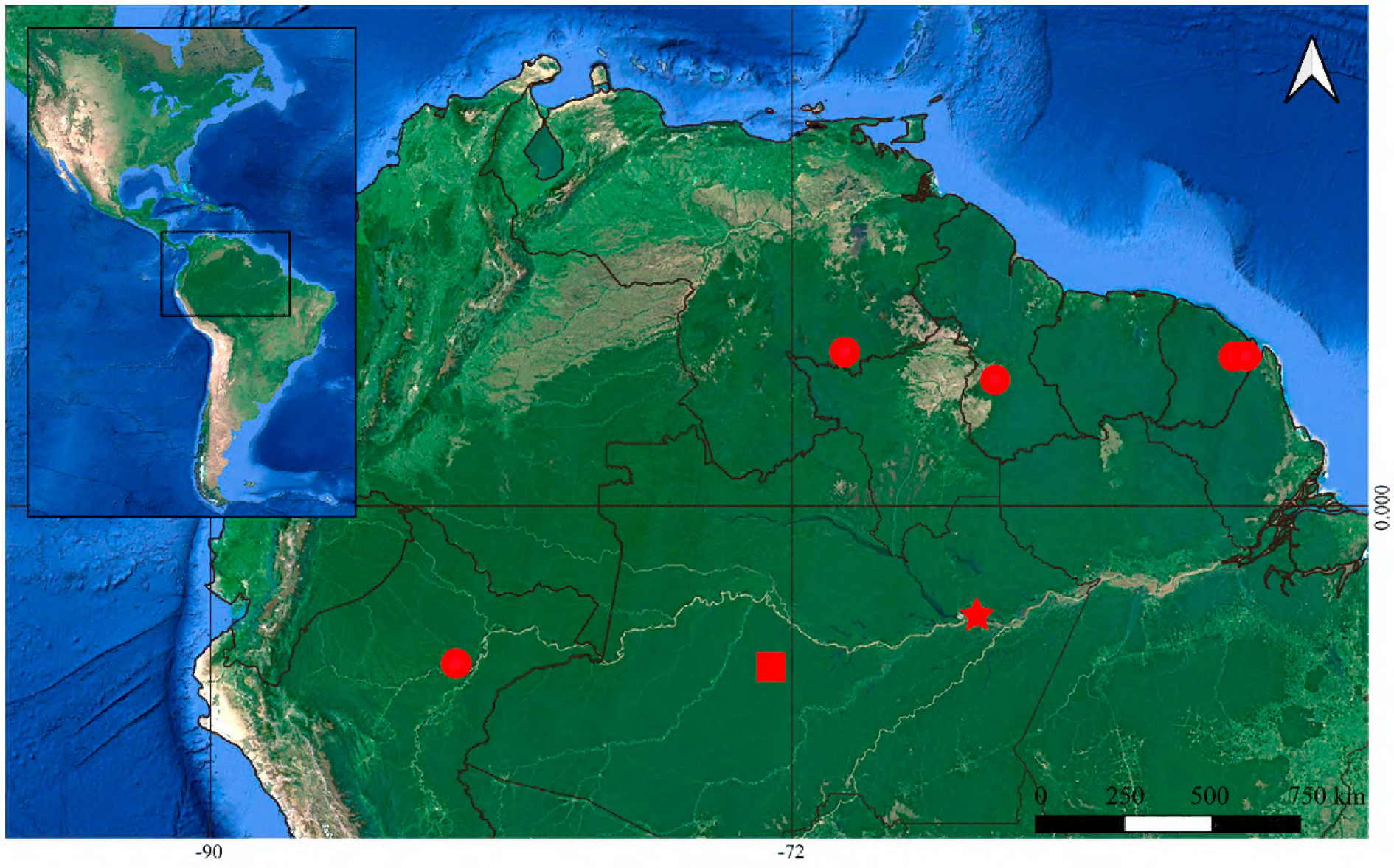


**Figure 6.** Current distribution of *Bactrophora dominans* Westwood, 1842. Circles: known occurrences; square: new record, individual collected; star: new record, photographic record and data from iNaturalist.

(process no. 310032/2015-6). This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001). We are greatly indebted to Frederic Beneluz and J.L. Giuliaris (French Guiana), Jason Weintraub (Academy of Natural Sciences of Philadelphia, USA), Hugh Rowell (Universität Basel, Switzerland), Bernardo Espinoza and Carlos Hernández (Instituto Nacional de Biodiversidad, Costa Rica), Alessandro Giusti and George Beccaloni (Natural History Museum, London, UK), Mercedes París (Colección de Entomología, Museo Nacional de Ciencias Naturales, Madrid, España) and Thalisson Torres (Universidade Federal de Amazonas, Manaus, Brasil) for providing us with relevant information and/or photographs under their care of the *Bactrophora* insects.

## Authors' Contributions

DSMS identified the specimen on iNaturalist, raised distributional data and organized the manuscript. GT identified the pinned specimen, made the figures, and took the measurements. MF found the specimen information, and built the map. JMG provided information on the types of both species, as well as details on the other known *B. dominans* specimens. All authors participated in the writing process of the manuscript.

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